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3.1 PURPOSE

This section describes maintenance inspections of the bridge's structural items. Inspections assess the condition of the bridge and identify deficiencies. Maintenance guidelines are set up for periodic cleaning, adjustment, or servicing of specific items. For each item, the frequency of maintenance is based on recommendations by the manufacturers and guidelines established by the Mercer Island Bridge Crew and Bridge Preservation Office. Inspection and maintenance forms are provided in Section 6. All maintenance activities are to be recorded and all inspection and maintenance forms are to be maintained by the Northwest Region Bridge Office.

3.2 GENERAL INSPECTION INFORMATION

3.2.1 Safety Equipment - Portable GFCI Cord Sets

Portable power cords with Ground Fault Circuit Interrupting protection are provided in MIBS. All persons using portable electrical equipment in the pontoons shall use the portable power cord sets. The cord sets are plugged in the wall or ceiling mounted receptacle and the electrical equipment is then connected to the power cord set. The power cord set will protect the user from electrical shorts related to working in wet or damp environments that the exiting power panel is not equipped to prevent.

3.2.2 Safety Equipment - Personal Light Source (Flashlight).

All persons entering or working in the pontoon should be equipped with an emergency flashlight or similar light source. In the event of a power outage, the pontoons do not have battery powered back up lighting to illuminate the safe path for egress from the pontoon.

3.2.3 Lockout/Tagout Procedures

No electrical apparatus or electrically driven apparatus should be worked on while energized. The appropriate circuit breakers or disconnect handles for the equipment being worked on shall be locked in the open (off) position and tagged. The appropriate immediate upstream circuit breaker or protective device should always be used to electrically isolate the equipment. A sign should be posted at the control panel to identify that the devices are tagged out of service. A contact person shall be identified on the tag.

3.3 HOW THIS SECTION IS STRUCTURED

This inspection and maintenance section is divided into subsections that group items by location. Each subsection describes an item, the number of such items, location, the inspection procedures, and/or the maintenance frequency and procedures. Photo references are included where applicable. Section 6 Inspection and Maintenance Forms are identified for the specific item.

3.4 PONTOON INTERIOR

A pontoon is a support device that floats. In the case of the Homer Hadley Bridge (HHB), a pontoon is a massive rectangular hollow concrete box, sealed on all six sides. The top of the box is the roadway for the central deck pontoons, and supports the piers of the elevated structure on the east and west ends of the bridge. The pontoon is held afloat as a result of buoyancy; the upward force on an object immersed in water is equal to the weight of the displaced water.

Each pontoon floats on the lake surface and is anchored to the lake bed by at least two long steel cables. In

addition, a typical pontoon is connected, end to end, to two other pontoons. Therefore, each individual pontoon is held in position by three different methods. Buoyant forces act vertically, anchor cables provide lateral support, and the bolts connecting pontoons to one another provide longitudinal support. Collectively, all the pontoons held together stretch across the lake to form the bridge.

The HHB consists of 18 pontoons. The typical pontoon is 354 ft. long, 75 ft. wide, and between 25 ft. and 16 ft deep. The pontoons are identified by letters "A" on the west end, to "R" on the east end. Each pontoon consists of an internal lattice of perpendicular and parallel walls, which form a neat arrangement of cells.

Concrete Deterioration

The Homer Hadley Bridge is constructed from prestressed reinforced high strength concrete. If, during an inspection, cracking, delamination, reinforcing steel corrosion, spalls, or other defects are found to exist, this information should be indicated on the field inspection forms.

A crack is best thought of as a fracture in the concrete caused by a level of tension that the concrete strength is incapable of resisting. Typically, a crack is classified as hairline, medium, or wide. Hairline cracks are too thin to measure and generally reflect no structural significance. Medium and wide cracks (>1/64 in.) occurring in prestressed concrete are significant. If a medium or wide crack is found, the location, width, orientation (vertical, horizontal, or diagonal), and length of the crack require documentation. The crack length must be traced and dated with chalk on the pontoon surface. This procedure provides a means to monitor crack growth.

All concrete cracks are caused by tension forces. These forces result from stresses generated by external loads applied to the structure or from stresses generated within the structure. Ambient temperature fluctuations, resulting in contraction or expansion of the concrete, or shrinkage of the concrete during the curing process after construction, can both cause stresses to generate within the structure.

A vehicle traveling over the pontoons is one source of external forces. A second source of external forces affecting the pontoons is a severe storm, which causes significant increases in wind and water pressure. A third source of external forces is impact from a boat or other floating objects.

Once a crack has developed, it can lead to further deterioration of the concrete, especially if water is able to penetrate the crack and cause the internal reinforcement to corrode. Since rust requires a ten-fold increase in space around the steel, it will exert an expansion force at the reinforcement/concrete interface, which may lead to a separation of the concrete from the steel bars. This separation is known as a delamination.

Concrete that experiences delamination sounds hollow. These areas can be detected by hitting the concrete surface with an ice pick hammer in suspect locations. If the hammer impact results in a "thud" like sound and the blow feels dampened, then it is likely that the delamination process is occurring. If the hammer impact results in a "ping" sound, and the hammer springs back after impact, then the concrete is in good condition.

Rust stains on the concrete surface are important to note during the inspection, and are often visible in areas of cracks. A rust stain is direct evidence that the reinforcement inside the wall has begun to corrode. In addition to delamination of concrete, corrosion of the reinforcement will eventually lead to a loss of strength in the entire component.

A spall occurs on a concrete surface when a chunk or piece of surface becomes separated and falls off of the component. The final effect is a depression or a hole in the surface, often resulting in exposure of the reinforcement.

Efflorescence is made visible by a thin coat of white crystallized powder on the concrete surface. The crystallized powder is deposited on the surface by moisture that has penetrated the concrete. In the process of

migrating through the component, the moisture dissolves salts. The salts are then carried by the moisture to the surface. Concentrated amounts of efflorescence are often found in cracks where the leaching process is amplified. Usually efflorescence found in cracks indicates that the crack or fracture extends through the concrete component.

3.4.1 Cells

Description

The internal cellular arrangement of walls in the pontoon provides a strong structural system to support the highway traffic and to resist the forces generated by wind and waves pushing against the side walls. In addition, any water that enters a cell is isolated from neighboring cells, thereby facilitating removal using pumps.

Each cell is made of four vertical walls, and a top and bottom slab. The typical cell dimension is 30 ft. long, 15 ft. wide and about 16 ft. high. All walls and slabs in the pontoons are made from prestressed high strength concrete.

Refer to photo numbered 5-3.

Number of Items & Location

There are 65 cells in each of pontoons B, C, D, E, P, and Q. Each of these pontoons has five rows and thirteen columns. There are 60 cells in each of pontoons F through O. Each has five rows and twelve columns. Transverse end pontoons A and R contain 45 cells each. Thus, the total number of cells in the Homer Hadley Bridge is 1080. All cells are accessible.

Inspection Procedure (Use Forms 6-7, 6-20, 6-21)

The cells should be completely dry. If water is found inside a cell it should be the result of condensation only. The balance of the entire bridge can be affected if too much water enters a single pontoon and causes that pontoon to tilt. This, in turn, would cause undue stress on other components such as anchor cables, connection bolts, and the prestressing strands tying the pontoons together. In addition, water promotes corrosion of materials. If water is discovered inside a cell in quantities that exceed condensation potential, the source must be identified and the problem corrected.

The top slab of each cell supports or serves as the roadway deck. As a structural unit, the top slab transfers vehicle loads to the cell walls. Because the top slab experiences extremely high repetitive stresses, it is prone to deterioration. The bottom slab is in constant resistance to the buoyancy force exerted by the water. Though this force is significant, it remains relatively constant. The outside face of the exterior walls of perimeter cells is susceptible to impact damage from boats or other large floating objects.

- ❑ Inspect concrete surfaces. Look for damage, cracks, spalls, rust stains, exposed rebar, delamination, and efflorescence.

- ❑ Look for water accumulation. Check the depth and source.

3.4.2 Watertight Doors

Description

In the event of a major water leak, watertight doors will ensure that the water remains contained in either the

cell or group of cells where the leak is occurring. The steel doors provide a seal for the 4 ft. by 2.5 ft. openings that allow access from one cell to another.

The outside perimeter of each watertight door contains a rubber gasket. When the door is in the closed position and the locking mechanism is engaged, the gasket becomes tightly and uniformly compressed against the door frame, thereby developing a watertight closure.

The watertight doors are painted black with an oil base paint. Six long thin bars that radiate out from the central hub are controlled by a large wheel, and serve as the door locking mechanism. It is possible to open the door from either side.

Refer to photos numbered 5-3 and 5-5.

Number of Items & Location

Watertight doors are located throughout the interior of all pontoons. The doors are arranged throughout the pontoon to contain flooding water in the exterior cells. A second set of doors are positioned to contain the water in groups of five transverse cells. Doors are also positioned at the openings of cells that contain roadway drain pipes. There are a total of 522 watertight doors.

Inspection Procedure (Use Form 6-7)

The two parts of the door which will require special attention are the rubber seals and the locking mechanisms. It is important for the rubber to remain elastic and supple to provide a true seal.

The doors must be left open when entering a cell and moving further into a pontoon. Conversely, the doors must be locked when leaving a cell and moving in the direction of the access hatch.

- ❑ Inspect the locking mechanism and hinges. Check the quality of operation and the condition of lubrication.

- ❑ Check the condition of the seals. Look for brittleness and cracks.

- ❑ Check the condition of the overcoat. Look for peeling and cracking.

Maintenance Schedule and Procedures

Ten years (Use Form 6-19)

In any given year service two pontoons, in accordance with the findings of the inspection.

- ❑ Re-paint door as needed. Painting operations must conform to painting regulations for confined spaces. All existing rust, dirt, grime, or any other material that would inhibit the proper adhesion of the new paint to the metal surface door must be removed prior to application of new paint.

- ❑ Perform a chalk test on the seal to ensure that continuous contact at the perimeter between the door frame and the door seal is achieved. To perform this test, place a uniform coat of chalk along the perimeter of the door seal interface. Close the door and lock it. Re-open the door and view the door frame seal perimeter to see if a continuous and uniform imprint of the chalk is present. If there is not a continuous and uniform imprint of chalk present, then the seal should be replaced.

- ❑ Replace existing seal as needed. Perform a chalk test, as described above, on the new seal to ensure

that continuous contact at the perimeter between the door frame and the door seal is achieved. The test is not successful until the chalk imprint confirms that a continuous seal is achieved.

- ❑ Lubricate door locking mechanism and door hinges as needed. Use Chevron Ultra-Duty Grease EP NLGI 2.

3.4.3 Connection Bolts

Description

Connection bolts are long steel rods that hold adjacent pontoons together. The bolts are approximately 15 ft. long and 2-1/4 in. diameter. The rods are passed through circular ducts on the pontoon end wall anchor, through the watertight interface between successive pontoons, and into a circular duct in the next pontoon's end wall anchor. Once in position, the rods are bolted at each end using heavy hex nuts. The nuts are tightened at both ends, causing the pontoons to compress together. The steel bearing plate positioned between the nut and the concrete surface is 2 in. thick.

The connection bolts are evenly spaced around the perimeter of the end walls of each pontoon. The threaded end portion of the rod, hex nut, washer, and plate are exposed inside the pontoon. The ends are coated with grease to prevent corrosion of the steel.

Refer to photo numbered 5-6.

Number of Items & Location

The HHB utilizes 114 connection bolts at both the east and west end walls of each pontoon, with the exception of the pontoons of the elevated spans, where an embedded prestressing strand system is used. On the average there are 20 connection units per interior end cell and 27 units per exterior end cell. The connection bolt system is utilized in pontoons E through P (12 pontoons total).

Inspection Procedure (Use Form 6-7)

The primary problem affecting the connection unit is the corrosion of the rod and bolt.

- ❑ Inspect all metal parts. Look for corrosion, pitting, and tightness.
- ❑ Inspect the grease coat. Look for deterioration.
- ❑ Check the quality of the seal. Look for water leaks, concrete rust stains, and loose components.
- ❑ Inspect the adjacent concrete. Look for spalls, cracks, delamination, and efflorescence.

Maintenance Schedule and Procedures

Annually (Use Form 6-7)

- ❑ Re-apply a new coat of grease, as necessary, to the end of each connection bolt, washer, and bearing plate. The grease should cover all exposed steel material associated with the connection. Spray with Chevron Open Gear Lubricant SP.

3.4.4 Catwalks and Ladders

Description

Each pontoon is equipped with an elevated catwalk for the purpose of providing access to every cell for inspection and maintenance repair work. The catwalk system is a steel grating platform supported by steel hanger rods and angles bolted into the top slab and walls. All steel components are galvanized. The platform is 3 ft. 6 in. to 3 ft. 10 in. wide. Catwalks are aligned with all door openings. A ladder extends from the catwalk down to the cell floor.

Refer to photo numbered 5-3.

Number of Items & Locations

The Homer Hadley Bridge has a catwalk and a ladder in each cell.

Inspection Procedure (Use Form 6-7)

- ❑ Check the structural condition of the ladders, grating, and hangers. Look for corrosion, loose connections, excessive deflection, and rattling.
- ❑ Check the condition of galvanizing. Look for rust and cracking.
- ❑ Inspect the concrete at connections. Look for spalls and cracks.

3.4.5 Bridge Drain System (Pontoon Interior)

Description

The bridge drains provide passage for the discharge of roadway runoff. The typical deck pontoon on the HHB has two 7 ft. wide by 5 ft. deep catch basins. The catch basin is a concrete box constructed integral with the pontoon.

Inside the basin there is a 1ft. 6 in. circular opening, to which a 12 in. corrugated metal pipe (CMP) is connected. Roadway runoff is discharged through the CMP, which passes through the south wall of the pontoon.

Refer to photo numbered 5-7.

Number of Items & Location

The catch basins are constructed integral with the pontoons, located directly below the roadway drains (gratings). One catch basin serves two parallel roadway drains located on opposite sides of the median barrier. The basins are located only in the deck pontoons. Pontoons J and P each have three catch basins, while the rest of the deck pontoons each have two catch basins. There are a total of 30 catch basins and 30 corrugated metal pipes on the HHB.

Inspection Procedure (Use Form 6-7)

- ❑ Inspect the corrugated metal pipe. Look for evidence of leakage, corrosion, cracks, and poor seals at the inlet and discharge points.

- ❑ Inspect the catch basin. Look for evidence of leakage, corrosion, and cracks.

3.5 PONTOON EXTERIOR

On the east and west ends of the bridge, the roadway rises to meet the higher land elevations. This grade transition is accommodated by a series of pontoons supporting a gradually rising elevated bridge. These parts of the bridge are called elevated spans. In general, the structural and internal design of the elevated span pontoons is similar to that of the deck pontoons.

The pontoons of the elevated spans function principally as large floating footings supporting the substructure of the elevated roadway. The substructure of the elevated roadway is composed of two end pier walls and intermediate concrete hammerhead piers with crossbeams. The superstructure utilizes steel box girders.

The west end elevated roadway of the HHB is 835 ft. long, and consists of fourteen spans. The east end elevated roadway is 126 ft. long, and consists of two spans.

In addition to the elevated structure, inspection and maintenance items in this section include items exterior to the central deck pontoons of the bridge.

3.5.1 Top Slab

Description

The top slab provides a protective shield for each pontoon, primarily against the rain and waves, and completes the pontoon's structural form (torsional box). It serves as the roadway deck on the central deck pontoons, and supports the piers on the elevated spans. The concrete slab has a varying thickness across the width of the pontoon. Consult the contract drawings for details as necessary.

A protective railing is positioned along the perimeter of the top slab on the pontoons of the elevated spans. It is a safety measure for the maintenance personnel. The railing is 3.5 ft. high, and utilizes a three wire rope system.

Refer to photo numbered 5-8.

Number of Items & Location

The top slab extends across the top of all eighteen pontoons. The protective railing is located along the perimeter of the top slab on the pontoons of the elevated spans.

Inspection Procedure (Use Forms 6-2, 6-8, 6-9, 6-10)

(See Section 3.5.7)

Since the top slab experiences extremely high repetitive stresses, it is prone to deterioration.

- ❑ Check the condition of the concrete. Look for cracks, spalls, rust stains, and exposed rebar.
- ❑ Check for distress around the pier base. Look for cracks and spalls.
- ❑ Inspect the protective railing. Check for secure posts, tight cables, and look for corrosion.

- ❑ Inspect conduit supports.

3.5.2 Access Hatches

Description

The access hatches on the HHB provide the only simple access into the pontoon for inspection and maintenance purposes. The hatches are hinged 2 ft. by 2 ft. galvanized steel plates which, when bolted shut, cover the access openings. The openings on the deck pontoons are located on the roadway. The hatches are secured by a combination of six rotating wedge bars positioned along the door perimeter, below the roadway. The locking device can be used to rotate the wedge bars from above the roadway.

The hatches have a seal for the purpose of restricting leakage of the roadway runoff through the opening when the hatch is in the closed position. The seal material is a rubber gasket with a durometer hardness of 50. The hatch gaskets and locking mechanism do not provide a watertight seal. However, if the hatch is properly closed and the seal is in good condition, water penetration into the pontoon should be greatly restricted.

Refer to photo numbered 5-8.

Number of Items & Location

There are two access hatches near the center of each typical pontoon, located on the east and west sides of the pontoon anchorage wall. Each opening thus provides access to either the east or west half of a pontoon. On each end pontoon, one hatch is located on each side of all four anchorage walls, and two hatches are located in the center of the pontoon. Thus, there are ten hatches located on each end pontoon, and two hatches located on all other pontoons. The HHB has a total of 52 access hatches, which require routine maintenance.

Inspection Procedure (Use Forms 6-2, 6-8, 6-9, 6-10)

One common defect of access hatches is deterioration of the rubber or neoprene gasket, which results in a less water resistant seal. Other common defects include damage to the cover plate and corrosion of the closure bolts, which inhibit easy removal of the hatch.

- ❑ Check for deterioration of the seals.
- ❑ Check for damage to the hatch cover.
- ❑ Check condition of locking device.
- ❑ Look for corrosion of metal parts.
- ❑ Check for ease of hatch removal.
- ❑ Look for evidence of leakage.

Maintenance Schedule and Procedures

Annually (Use Forms 6-8, 6-9, 6-10)

- ❑ The Bridge Supervisor will review the most recent maintenance inspection report to identify which seals are no longer functioning properly, are brittle, and are generally in a state of deterioration.

- ❑ Develop a work schedule that will provide for systematic replacement of all defective seals. Replacement of all defective seals is to be performed no later than 90 days after the annual inspection.

- ❑ Replace gaskets if they are no longer providing an adequate seal. If a gasket needs to be replaced, remove the existing gasket, clean and smooth out the steel surface, apply adhesive, and then place the new gasket.

3.5.3 Piers

Description

Piers transfer the deck loads (traffic included) to the pontoons. They are made from reinforced C.I.P. concrete. The HHB has two end pier walls and intermediate concrete hammerhead piers with crossbeams. The pier columns and crossbeam are constructed as an integral unit. The bearings and the steel girders are supported on top of the crossbeams. The tallest pier is approximately 33 ft. in height, and the shortest pier is 6 ft. in height.

The end piers of the elevated spans have aluminum fencing at openings accessible to birds. The purpose of the fencing is to block the birds from entering the enclosed spaces.

Refer to photos numbered 5-9, 5-10, and 5-11.

Number of Items & Location

There are a total of eighteen piers on the elevated spans. Fifteen are located at the west end of the bridge, supported by pontoons A, B, C, and D. The remaining three are supported by pontoons Q and R, at the east end of the bridge. The piers are named according to the pontoon that they are supported by. The piers on the HHB are named A1, B1, B2, B3, B4, B5, B6, C1, C2, C3, C4, C5, C6, D1, Wall D10, Q1, Wall Q16, and R1. Refer to figure 1.2.

Inspection Procedure (Use Forms 6-2, 6-8, 6-9)

The top of a pier crossbeam is called the bearing seat area. This area, if below an expansion joint, will be susceptible to roadway runoff when the joint seal begins to deteriorate. Pigeons may also use this area for nesting purposes, leaving behind excessive debris which, when wet and mixed with roadway runoff, creates a corrosive environment. This is potentially damaging to the concrete and the bearings, and makes adequate future inspections difficult. Pigeon debris should be removed annually. In addition, the pigeon fencing should be repaired when broken.

- ❑ Check the condition of the concrete. Look for cracks, spalls, rust stains, exposed rebar, and efflorescence.

- ❑ Inspect the bearing grout pad. Look for cracks, deterioration, spalls, and movement.

- ❑ Look for pigeon debris.

- ❑ Inspect pigeon fencing. Look for areas that are broken.

- ❑ Inspect expansion joint. Look for leakage.

3.5.4 Bearings

Description

The bearings, which are located on the top of the pier cap (or bearing seat), transfer all superstructure loads to the substructure (piers). Two fundamental types of bearings exist on the Homer Hadley Bridge: fixed and expansion. Fixed bearings allow for rotation only, while expansion bearings allow for both rotation and translation (longitudinal or transverse movement).

There are two types of fixed bearings on this bridge. The first type is a pinned bearing. These bearings allow the girders to rotate in the longitudinal direction of the girder, but fix them against sliding either forward or backward in response to contraction or expansion forces induced by temperature fluctuations. The pinned bearing consists of two 1-1/4 in. diameter anchor bolts, a grout pad, a 2 in. steel base plate, a curved rocker plate and a tapered sole plate.

The second type of fixed bearing consists of a grout pad, one 2 in. diameter steel anchor bolt, an elastomeric bearing pad glued to the grout, and a steel sole plate resting on the elastomeric pad. The anchor bolts may have to resist temperature-induced movement of the girders and must therefore be checked for bending or shear. This will occur only if the expansion end is frozen.

There are also two types of expansion bearings on the Homer Hadley Bridge. The first type of expansion bearing is similar to the second type of fixed bearing, with one difference: the anchor bolt is not snug fit to the girders (as in the fixed case). Instead, at 64 degrees Fahrenheit, the bolt is positioned at the center of a slotted hole. The slotted hole allows the girders to contract or expand with fluctuating ambient temperatures. Thus, it is imperative that the slots remain clean of debris or corrosion build-up.

The multi-directional spherical bearings at Piers A1 & R1 are also expansion bearings. They allow longitudinal movement through a stainless steel/sliding plate mechanism, as well as rotation through a spherical bearing. The spherical bearing consists of a 1-1/4 in. thick steel plate, with a flat surface on one face and a concave surface on the other. Both surfaces have a 1/8 in. sheet of P.T.F.E. electrochemically bonded to the steel. This provides the interface on which the stainless steel upper sole plate slides or the lower stainless steel sole plate rotates.

Refer to photos numbered 5-9, 5-10, and 5-11.

Number of Items & Location

Bearing Type	Locations	Total Number
Pinned (fixed)	Piers B2, B3, B5, B6, C2, C3, C5, C6, Q1	90
Elastomeric Pad (fixed)	Piers A1 (the east set of bearings) & Wall D-10	20
Elastomeric Pad (expansion)	Piers B1, B4, C1, C4, D1, R1 (the west set of bearings) & Wall Q-16	70
Spherical (expansion)	Piers A1 (the west set of bearings) & R1 (the east set of bearings)	20

Inspection Procedure (Use Forms 6-2, 6-8, 6-9)

Note excessive impact, vibrations, or rattling noises from trucks at the bearing locations. Verify that each girder's ability to move longitudinally is not inhibited in any manner. For example, check that the ends of the web or flange of the two adjacent girders are not butted up against each other.

- ❑ Check for corrosion to either the bearing or the anchorage.
- ❑ Check for movement hindered by debris build-up.
- ❑ Look for rockers that have moved beyond their normal limits.
- ❑ Check for loose or missing fasteners.
- ❑ Look for spherical bearings that are at or beyond their normal working range.
- ❑ Check for gouged sliding plate surfaces.
- ❑ Check for dislodged P.T.F.E. sheets. Note: a small amount of P.T.F.E. material will be visible on the stainless steel surface, which is considered normal wear for this type of bearing interface.
- ❑ Check elastomeric pads for excessive bulging, or any splitting or tearing.

Maintenance Schedule and Procedures

Annually (Use Forms 6-8, 6-9)

- ❑ Clean away all debris, including pigeon remains, from pier caps and bearings.

3.5.5 Girders

Description

The steel girders directly support the elevated roadway and all traffic utilizing this portion of the roadway. They are made from ASTM A-588 corrosion resistant steel. Each girder measures 7 ft. across the top, 4 ft. across the bottom, and 3 ft. vertically on each side (including a 9 in. concrete slab).

The girder shape is a hollow box, framed by thin steel plates and the concrete deck. The bottom flange and two side webs are steel and the top flange is steel and concrete. The concrete portion of the top flange also serves as the roadway slab. The slab is connected to the steel by shear studs located on the steel top flange above the web plates.

Hatch openings in the bottom flange provide inspection access to the inside of each steel box girder. The openings are 2 ft. by 2 ft.

A vent hole allows air to move in and out of each box girder, providing ventilation and reducing condensation inside the box. The vent hole has an 11 in. diameter and is positioned on the vertical face of the girder end-diaphragm near the hatch openings. A screen is used to prevent birds from entering the girder.

Refer to photos numbered 5-9, 5-10, and 5-11.

Number of Items & Location

There are ten girders on the bridge, which comprise a distance of 834 ft.

The girder hatch door is positioned on the bottom side of the girder and swings down to open. A girder hatch is located near piers B1, B4, C1, C4, D1, and Q1.

Inspection Procedure (Use Forms 6-2, 6-8, 6-9)

- ❑ Inspect the steel surfaces. Look for corrosion, bent or warped plates, cracks, loose bolts, cracked or peeling paint, and bends.
- ❑ Inspect the underside of the metal deck forms. Look for rust stains, leakage from the deck, cracks, leaching, efflorescence, spalls, and exposed reinforcement.
- ❑ Check for inside moisture build-up. Look for plugged drain holes.
- ❑ Inspect the girder hatch openings. Check the overall condition of the lock mechanism, hinges, and seals.
- ❑ Inspect the girder ventilation holes and screens. Check the general condition, and look for corrosion.

Maintenance Schedule and Procedures

Annually (Use Forms 6-8, 6-9)

- ❑ Maintenance personnel should spot paint, as needed.

8 to 10 years

- ❑ The overcoat system on the steel girders should be evaluated to determine the need for application of a new coat of paint. This evaluation is done by the Bridge and Structures Office.

3.5.6 Outside Wall

Description

The outside wall is 10 in. thick and serves as the vertical face of a pontoon section. It is reinforced with normal grade 60 epoxy coated rebar and high strength prestressed steel strands. There is 1.5 in. of concrete covering the reinforcement. The north and south walls on the bridge also serve as the supports for the sidewalk and roadway cantilevers, respectively. The cantilevers are concrete slabs projecting 16 ft. over the water from the top edge of the pontoon. The south overhang also provides support for twelve utility lines.

Refer to photos numbered 5-13, 5-14 and 5-24.

Number of Items & Location

The outside wall extends around all eighteen pontoons. The total perimeter length of the outside wall is 12,315 ft., or 2.3 miles. Approximately 7 ft. of the total wall height is typically above the water line, and the remaining portion of the wall extends 13 ft. to 17.5 ft. below the water line. The deck pontoons sit slightly deeper in the water than the pontoons of the elevated spans.

There are two concrete cantilevers on the Homer Hadley Bridge. One is located along the north side of the bridge, which is the structural support for the sidewalk, and the other is located along the south side of the bridge, and is the structural support for a traffic lane.

Inspection Procedure (Use Forms 6-11, 6-12)

The condition of the outside wall is important to the overall safety of the bridge. The underwater portion of the outside wall inspection will be included with the anchor cable underwater inspection and is thus not the responsibility of the Region Maintenance branch.

Damage to the exterior walls from a boat or other heavy floating object was the most likely cause of damage to the walls during the early years of the bridge's life. However, as the bridge ages, deterioration of the concrete resulting from potential corrosion of the internal reinforcement becomes more important.

- ❑ Check for cracks.
- ❑ Check for deterioration or damage.
- ❑ Check for spalls.
- ❑ Look for rust.
- ❑ Look for exposed rebar.
- ❑ Check for delamination.
- ❑ Check the condition of the conduit supports.
- ❑ Check the condition of the bilge pipe supports.
- ❑ Inspect the draft marks.

3.5.7 Roadway Deck and Sidewalk

Description

The roadway deck provides the riding surface for vehicles. It transfers the vehicle loads to the pontoon cell walls or to the steel girders on the elevated spans.

The deck is made from reinforced concrete. The thickness varies along the width due to haunches at the cell walls, but the nominal thickness is 9 in. The actual deck is not visible. The visible feature is a 1.5 in. thick, high density, latex modified concrete overlay system. The overlay serves as a smooth riding surface, and a protective membrane for the deck. The roadway length is 1.1 miles, or 5736 ft. The slab width is 106 ft.

The sidewalk is 10 ft. wide, and is supported on the north side of the bridge by a concrete cantilever. It provides a pedestrian and bicycle route across Lake Washington. The sidewalk has a pedestrian railing, which rises 4.75 ft. above the sidewalk. Each railing support is anchored to the pontoon side by four stainless steel bolts, ½ in. diameter by 12 in. long. The railing and the anchor brackets are aluminum.

Refer to photos numbered 5-8, 5-12, 5-15, and 5-16.

Number of Items & Location

The roadway deck is the top slab of the pontoons, except at the east and west ends of the bridge, where it is part of the elevated roadway.

There is only one sidewalk on the Homer Hadley Bridge. It extends along the north side of the bridge, and is supported by a concrete cantilever.

Inspection Procedure (Use Form 6-10)

The occurrence of potholes is the most common problem associated with overlay systems. Trucks driving over the potholes generate excessive impact on the concrete slab, causing vibrations at the girder/bearing connections. In addition, repetitive impact loads can introduce small cracks into the bridge deck, and reduce the fatigue resistance of steel girders.

Cracks in the overlay and deck will lead to corrosion of the deck reinforcement and possible slow seepage of deck runoff into the pontoon interior. In addition, the safety and riding comfort of vehicles utilizing the bridge will be reduced.

Cracking through the concrete overlay at the joints between successive pontoons is to be somewhat expected. If these cracks do occur they should be monitored to help ensure that they do not propagate into spalls or potholes, which would result in deck runoff seeping into the vertical joint between pontoons, and potentially causing damage to the seals at the pontoon to pontoon interface. The roadway deck on the elevated spans should be checked from both the roadway, and from the lower deck.

The most common defect associated with the sidewalk railing is damage to the slender 1.25 in. baluster pipes.

- ❑ Inspect the deck. Look for potholes, rutting, large cracks, and general wear of concrete (LMC) overlay.
- ❑ Inspect the sidewalk. Look for spalls, cracks, rust stains, and check the general condition.
- ❑ Inspect the pedestrian railing. Look for any damage, and check for distress around the anchor bolt connection.
- ❑ Inspect the bottom of the deck on the elevated spans.

3.5.8 Traffic Barriers

Description

The traffic barriers are a safety device. They protect vehicles from head-on collisions, driving off the bridge, or hitting pedestrians and bicyclists. Standard reinforced concrete barriers are used.

Refer to photos numbered 5-8, 5-12, 5-15, and 5-16.

Number of Items & Location

There are three traffic barriers on the bridge. They extend the full length of the roadway. One is located on the north side of the bridge, one is located on the south side, and the third functions as the median barrier between the express lanes and the other traffic lanes.

Inspection Procedure (Use Forms 6-2, 6-10)

Damage to traffic barriers and barrier anchorage can be caused by vehicle impact. Typical damage usually involves spalling and scraping of the concrete and possible exposure of reinforcement. In addition, general deterioration of the concrete in the form of spalling, rust stains, and efflorescence is accelerated by de-icing liquids. Also, existing shrinkage or temperature cracks in the concrete may continue to propagate.

- ❑ Check for correct alignment.
- ❑ Look for impact damage.
- ❑ Check for cracks.
- ❑ Check for rust stains.

3.5.9 Bridge Drain System (Pontoon Exterior)

Description

The roadway drainage system facilitates the removal of all runoff from the roadway. Runoff generally refers to rain fall or snow melt. Open deck gratings are located at the low point of the roadway cross section. The open grating allows the runoff to fall into a catch basin, which is located in the interior of the pontoon. The runoff is then deposited through a drainage pipe.

Drainage for the sidewalk is achieved by 3 in. diameter pipes positioned vertically in the sidewalk concrete.

Refer to photos numbered 5-14 and 5-15.

Number of Items & Location

Typically, there are four grates per deck pontoon: two on the north side and two on the south side of the median barrier. The exceptions are pontoons J and P, which each have six. There are a total of 60 roadway open deck gratings on the bridge.

There are seven sidewalk drains per pontoon. The drain pipes are recessed ½ in. into the sidewalk, which is on the north cantilevered section of the bridge.

Inspection Procedure (Use Forms 6-10, 6-11, 6-12)

The deck grating and the catch basin will periodically become clogged with dirt and leaves, which inhibit the drainage of water from the road surface. If the drainage flow is restricted during extensive accumulations of rain fall, the net result is a safety hazard for the vehicles using the bridge, as portions of the roadway become flooded.

- ❑ Look for ponding.
- ❑ Check condition of grating.
- ❑ Check general condition of drain pipe.
- ❑ Look for evidence of clogging.

3.5.10 Air Vents

Description

Each exterior cell on the bridge is equipped with a 6 in. diameter galvanized steel pipe air vent. These vents provide for some fresh air ventilation to the exterior cells of each pontoon. A flotation ball, located in the portion of the pipe inside the pontoon, prevents water from entering the pontoon through the vents, but allows passage of water from the pontoon to the outside. A screen is placed on the outside vent opening to prevent birds and other forms of debris from causing the vent to plug.

A fan is located on the top of the air vent in cells with bolted joints or anchor galleries. These fans create air circulation within the pontoon.

Refer to photo numbered 5-13.

Number of Items & Location

There is one air vent located in all north and south exterior cells of each pontoon. There are a total of 416 air vents on the Homer Hadley Bridge.

Inspection Procedure (Use Forms 6-7, 6-11, 6-12)

Inspect air vents from the interior and the exterior of the pontoon.

- ❑ Check for restriction of the air flow.
- ❑ Look for corrosion.
- ❑ Check flotation ball movement.
- ❑ Check for cracks or leaks at interface with the concrete.
- ❑ Look for damage to the air vent.

3.5.11 Deck Expansion Joints

Description

Deck expansion joints provide allowance for the superstructure to expand or contract in response to temperature changes. They also provide a sealed joint to prevent roadway runoff from leaking to areas below the deck. This prevents damage to the steel girders.

One type of seal on the bridge is a compression seal, which consists of a rectangle of neoprene with a honeycomb cross section. It is compressed between the pier wall and the deck. The other type of seal on the bridge is a strip seal, which consists of two slotted steel anchorages cast into the deck. A neoprene seal fits into the grooves.

Refer to photo numbered 5-16.

Number of Items & Location

There are a total of nine expansion joints on the bridge. The joints with strip seals are located at piers B1, B4,

C1, C4, and D1. The joints with compression seals are located at piers A1, R1, Wall D10, and Wall Q16.

Inspection Procedure (Use Forms 6-2, 6-8, 6-9, 6-10)

The most common problem associated with seals is general deterioration resulting from continual traffic impact, and both freeze/thaw and wet/dry cycles. If this deterioration occurs, the roadway runoff leaks onto the girder bearings and the end diaphragms, causing deterioration of these members. This is especially critical if de-icing liquids are used during the winter.

A perfect expansion seal has yet to be developed by industry. Thus, it is expected that the seals will eventually deteriorate, become ineffective, and require replacement. It is important to notice when the breakdown of the seal's sealing characteristics begins in order to initiate a replacement program before the bearings and girders, or their respective paint systems, are damaged by the runoff.

The expansion joint area is difficult to see from below due to space limitations and lack of light (a flashlight is normally required). Evidence of leakage from the roadway usually indicates that the expansion seal is broken. Therefore, the joint must also be inspected from above.

- ❑ Check seals for proper connection to both sides of joint.
- ❑ Check seal rubber for cracking, brittleness, or general deterioration of seal material.
- ❑ Check seals for evidence of leaks.

3.5.12 Modular Joints

Description

The modular joints provide for longitudinal and transversal relative motion between the central floating span and the fixed end spans of the bridge, without hindering the necessary structural connections between these spans.

These joints are intended to accommodate the expansion and contraction of the bridge resulting from temperature changes, and the transverse motion of the bridge resulting from wave and wind impact.

The modular joint is a combination of parallel steel tubes separated by an elastomeric gland, which can expand or contract. The steel sections are welded together, and the elastomeric gland is mechanically fastened to the steel tubes. The entire joint is anchored into the concrete.

Refer to photo numbered 5-16.

Number of Items & Location

There are two modular joints on the bridge. One is located above pontoon A, and the other is located above pontoon R. They extend the full width of the bridge.

Inspection Procedure (Use Form 6-10)

- ❑ Listen for banging sounds.
- ❑ Look for obvious cracks or other structural defects.

- ❑ Look for evidence of broken or ripped elastomeric gland.
- ❑ Check for evidence of leakage.
- ❑ Check for loose or missing shims.

3.5.13 Boater Protection System

Description

The boater protection system is a device intended to allow people on drifting boats to tie up before they are up against the bridge. A combination of buoys stretching the length of the bridge is set in the water. There are two types of buoys: the 20# buoy and the 400# buoy. The buoys are connected to one another by a ½ in. diameter phillystran aramid fiber rope. The phillystran is connected to pontoons A and R by a shackle and hook, and is supported at the water level by the buoys.

The large buoy is the 400# buoy, which has a minimum buoyant force capacity of 400 pounds. The 400# buoy is connected to the pontoon anchor cable with a phillystran. The phillystran is vertical at all anchor cables except Bn and Qn, where it is at a 60 degree angle with the horizontal. The 400# buoy serves as both the primary anchor for the buoy system, and the location marker for the pontoon anchor cables on the north side of the bridge.

The small buoy is the 20# buoy, which has a minimum buoyant force capacity of 20 pounds. One orange 20# buoy is placed midway between the 400# buoys. All other 20# buoys are white, and are spaced at 8 ft. intervals. The purpose of the 20# buoy is to keep afloat the phillystran, which runs the full length of the buoy system.

Refer to photo numbered 5-17.

Number of Items & Location

The combination of buoys stretches along the length of the pontoons and is located 100 feet north of the bridge. There is one 400# buoy per pontoon B through Q. There are 256 white 20# buoys and 15 orange 20# buoys. Thus, there are a total of 16 400# buoys, and 271 20# buoys.

Inspection Procedure (Use Forms 6-2, 6-11)

The phillystran at the water surface is supported by the 20# buoys. This allows for relatively easy inspection access to the phillystran by utilizing a small boat, but also makes the phillystran more susceptible to damage and corrosion.

The vertical phillystrans located at the 400# buoys anchor the buoy system. These phillystrans require an underwater inspection.

- ❑ Check the position of the buoys. Check that buoys form a straight line, and that there is no unusual drift.
- ❑ Inspect the buoys. Look for the degree of buoyancy, faded color or brightness, paint condition, deterioration of connection between phillystran and buoy, and damage.
- ❑ Inspect the phillystran and connections for wear.

- ❑ Inspect the shackle and hook on pontoons A and R. Look for corrosion, check tightness, and check the overall condition.

3.5.14 Fire Hydrants

Description

The Mercer Island Bridge Crew is responsible for the fire hydrants on the east end of the bridge. The fire hydrants on the west end of the bridge are the responsibility of others.

Number of Items & Location

There are two fire hydrants located on the east end of the bridge. They are located on the roadway, in parapet walls between small breaks in the traffic barrier.

Inspection Procedure (Use Form 6-2)

- ❑ Check fire hydrant for leaks.

Maintenance Schedule and Procedures

Annually (Use Form 6-10)

- ❑ Drain the fire hydrant.
- ❑ Charge the fire hydrant.
- ❑ Replace valves, as needed.